

AMENDMENTS TO THE SPECIFICATION:

Please amend the heading beginning at page 1, line 4, as follows:

Technical Field of Invention

Please amend the paragraph beginning at page 1, line 5, as follows:

The ~~present invention~~ technology described herein relates to automatic repeat request (ARQ) in data communication. In particular, the ~~present invention~~ technology described herein relates to the use of ARQ over fluctuating radio channels.

Please amend the heading beginning at page 1, line 10, as follows:

Background of the Invention

Please amend the heading beginning at page 3, line 16, as follows:

Summary of the Invention

Please amend the paragraph beginning at page 3, line 17, as follows:

~~Obviously an~~ An improved ARQ method{[,]} that quickly and automatically adapts to channel quality changes is needed.

Please amend the paragraph beginning at page 3, line 19, as follows:

~~The~~ An object of the ~~present invention~~ technology described herein is to provide a method, system and programs that overcomes the drawbacks ~~of the prior art techniques~~ described above. ~~This is achieved by the method as defined in claim 1, the system as defined in claim 11, the device as defined in claim 17 and the program product as defined in claim 9.~~

Please amend the paragraph beginning at page 3, line 23, as follows:

~~In the method according to the present invention a~~ A sender and a receiver are engaged in wireless communication with each other~~[[,]]~~ ~~wherein the~~ The sender is provided with an incoming data stream of a plurality of protocol data units (PDUs). The sender ~~transmit~~ transmits a plurality of PDUs which are at least partially overlapping ~~and with~~ at least two different transmission power levels ~~are being~~ used for the transmission of at least two different PDUs.

Please amend the paragraph beginning at page 4, line 1, as follows:

One example ~~embodiment of the method according to the present invention~~ comprises the steps of:

Please delete the paragraph beginning at page 4, line 22, which starts with:

The system according...

Please amend the paragraph beginning at page 4, line 28, as follows:

~~Thanks to the inventive method and system~~ The technology described herein provides a radio channel adaptation that is opportunistic with respect to channel variations ~~is provided~~. A higher

number of PDUs ~~will be~~ are transmitted when the channel so permits, and a lesser number if the instantaneous channel quality is low. ~~Whereby, the method ensures that at~~ At each transmission instance there will be a very high probability ~~of that~~ at least a part of the transmitted PDUs are correctly received, i.e., some information will almost always be transferred. This is in contrast to prior art ARQ schemes (both conventional and Hybrid schemes), wherein, in some cases, no information ~~at all~~ will be transferred.

Please amend the paragraph beginning at page 5, line 5, as follows:

~~One advantage of the present invention is that thanks to the ability of~~ Because of fast channel adaptation in combination with a high probability of some PDUs will be correctly received in every attempt, a less precise channel feedback is needed. In other words, the ~~invention~~ technology described herein increases robustness against unpredictable channel fluctuations. In addition, this adaptation is performed with relatively low complexity, ensuring a fast and reliable implementation.

Please amend the paragraph beginning at page 5, line 10, as follows:

~~A further advantage afforded by the method according to the present invention is that it offers is~~ backward compatibility to legacy terminals in most communication systems. ~~The idea is that~~ ~~base~~ Base stations and new terminals ~~implements~~ implement the novel ARQ- scheme, whereas legacy terminals ~~merely~~ see the coarsest level and decode the same, but with somewhat ~~degrade~~ degraded performance due to the interference caused by underlying (with respect to power level) PDUs.

Please delete the paragraph beginning at page 5, line 15, which starts with:

Embodiments of the invention...

Please delete the paragraph beginning at page 6, line 2, which starts with:

The invention will now...

Please amend the paragraph beginning at page 6, line 4, as follows:

Fig. 2 is a flowchart ~~over the method according to the present invention;~~

Please amend the paragraph beginning at page 6, line 5, as follows:

Fig. 3 is a message sequence chart ~~of the method according to the present invention;~~

Please amend the paragraph beginning at page 6, line 6, as follows:

Fig. 4 is a message sequence chart ~~illustrating an exemplary implementation of the method~~
~~according to the present invention; and~~

Please amend the paragraph beginning at page 6, line 8, as follows:

Fig. 5 is a schematic view of an exemplary implementation architecture ~~suitable for the present~~
~~invention; and~~

Please amend the paragraph beginning at page 6, line 10, as follows:

Fig. 6 illustrates the method ~~according to the invention~~ used on a channel that exhibit time
varying fading.

Please amend the heading beginning at page 6, line 13, as follows:

Detailed Description of the invention

Please amend the paragraph beginning at page 7, line 3, as follows:

The method ~~according to the present invention~~ provides an ARQ scheme that is well suited to a situation of changing channel quality. According to the method the sender transmits a set of multiple PDUs at essentially the same time multiplexed on different power levels and preferably with fairly low (code) rate for each PDU. Each PDU 205 in the set 210 is given a sequence number n and is assigned an individual code rate C_n and an individual power level P_n . The code rate and power levels are chosen so that between one and all transmitted PDUs are decodable by the receiver in presence of noise and interference. The number of decodable PDUs depends on the noise level, indicated at 215, and which powers the PDUs are received with. The PDU with lowest sequence number is preferably assigned the highest power, and the following sequence numbers are assigned with subsequent lower transmit power. If a PDU in the set that has failed the decoding process, a retransmission is ordered through a ACK or NACK procedure. The lost PDU is then given the lowest sequence number for the transmission, hence uses the highest power. Alternatively, or in combination, the PDUs are given different coding, i.e., different data rate.

Please amend the paragraph beginning at page 7, line 20, as follows:

~~For decoding can also various~~ Various known decoding methods may be used, such as Multi User Detection (MUD) schemes including Successive Interference Cancellation (SIC), Parallel Interference Cancellation (PIC), Maximum Likelihood Detection, etc.

Please amend the paragraph beginning at page 7, line 23, as follows:

An example embodiment, representing ~~the an example~~ basis for an implementation, of the ARQ method ~~according to the present invention~~ will be described with reference to the message sequence charts of FIG. 2 and 3 and the flowchart of FIG. 4. The method ~~comprise~~ comprises the steps of:

Please amend the paragraph beginning at page 7, line 27, as follows:

A number of PDUs from the ~~to the sender~~ incoming data stream $\{[,]\}$ are group into a set of PDUs. The PDUs are given respective sequence numbers according to $n, n+1, n+2, \dots, N+n-1$. The number, N , of PDUs in a set is typically given by the capability of multiple transmissions and/or decoding of the used modulation/multiplexing method and decoding method, respectively. N is typically a predetermined value, but can also be a parameter.

Please amend the paragraph beginning at page 8, line 22, as follows:

The transmitted PDUs are received by the receiver, decoded and checked for errors (CRC).

Typically are a subset of the PDUs correctly received. The rest of the PDUs are probably below the noise floor at the moment of transmission $\{[,]\}$ ~~as indicated in FIG. 4a,~~ and regarded as lost.

Generally the subset of correctly received PDUs comprises subsequent PDUs $n, n+1, n+2, \dots, R$,

wherein R represents the highest sequence number, corresponding to the lowest transmit power, P_R , that gave a correctly received PDU.

Please amend the paragraph beginning at page 9, line 20, as follows:

Illustrated in the message sequence chart of FIG. 3 is an example of ~~the a method according to the present invention~~ with four possible simultaneous transmissions ($N=4$), i.e. four power levels P_1, P_2, P_3 , and P_4 . The first set will comprise of PDU₁, PDU₂, PDU₃, and PDU₄ (step 405), with assigned power levels P_1, P_2, P_3 , and P_4 , and code rates C_1, C_2, C_3 , and C_4 (step 410). The transmission (step 420) results in that only PDU₁, PDU₂, are correctly received (step 425). The receiver ~~sends~~ sends a NACK message informing the sender that PDU₃, and PDU₄ were lost (step 430). At the sender a new PDU set is formed (step 435) with PDU₃, PDU₄, PDU₅, and PDU₆, which will be transmitted with power levels P_1, P_2, P_3 , and P_4 , respectively.

Please amend the paragraph beginning at page 10, line 25, as follows:

FIG. 6 ~~illustrated~~ illustrates the ARQ method ~~according to the invention~~ under operation in the time domain for a fading channel, where the coherence time is larger than the time slot durations used to send the PDUs. As shown in the figure, the number of PDUs that are correctly received will vary in time due to the variations of the radio channel and interference.

Please amend the paragraph beginning at page 11, line 3, as follows:

The ~~present invention~~ technology described herein is ~~exemplified~~ explained primarily in the ~~light~~ context of a flat channel. However, it may also be used over channel that varies e.g. OFDM with frequency selectivity.

Please amend the paragraph beginning at page 11, line 11, as follows:

The ~~present invention~~ technology described herein may also be used in conjunction of advanced antenna concepts including, but not limited to beamforming and MIMO based communication, for example.

Please amend the paragraph beginning at page 11, line 13, as follows:

The method ~~according to the invention~~ can be described as giving a radio channel adaptation that is opportunistic with respect to channel variations- a higher number of PDUs will be transmitted when the channel so permits, and a lesser number if the instantaneous channel quality is low.

~~Whereby, the~~ The method ensures that at each transmission instance there will be a very high probability of that at least a part of the transmitted PDUs are correctly received, i.e., some information will almost always be transferred. This is in contrast to prior art ARQ schemes (both conventional and Hybrid schemes), wherein, in some cases, no information ~~at all~~ will be transferred.

Please amend the paragraph beginning at page 11, line 21, as follows:

Alternatively, or in combination with the above, the ability of fast channel adaptation provided by the ~~present invention~~ technology described herein, may be utilized in that less precise channel feedback is needed, since the invention increases robustness against unpredictable channel fluctuations. In addition this adaptation is performed with relatively low complexity, ensuring a fast and reliable implementation.

Please amend the paragraph beginning at page 11, line 26, as follows:

The method ~~according to the present invention~~ offers backward compatibility to legacy terminals in most communication systems. This can be achieved in that base stations and new terminals implements the novel ARQ- scheme, whereas legacy terminals merely see the coarsest power level and decode the same, possibly with somewhat degrade performance due to the interference caused by underlying (with respect to power level) PDUs.

Please amend the paragraph beginning at page 12, line 3, as follows:

The method ~~according to the present invention~~ is preferably may be implemented for example by means of program products or program module products comprising the software code means for performing the steps of the method when executed on a computer. The program products are preferably executed on a plurality of entities within a network. The program ~~is~~ may be distributed and loaded from a computer usable medium, such as a floppy disc, a CD, or transmitted over the air, or downloaded from Internet, for example.

Please amend the paragraph beginning at page 12, line 9, as follows:

While the ~~invention~~ technology described herein has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, on the contrary, is intended to cover various modifications and equivalent arrangements within the appended claims.

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